

CLAIMS

I claim:

1. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions, comprising:

a dielectric barrier discharge non-thermal plasma (NTP) generation cell having a gas flow path therethrough, said cell having a plurality of electrically hot electrodes and ground electrodes positioned in the gas flow path so that gas flowing in the gas flow path will flow across a portion of these electrodes, at least the hot electrodes being hermetically sealed across the gas flow portion of the electrodes;

a cell gas inlet leading to the gas flow path through the cell; and

a cell gas outlet for discharging gas that has passed through the cell.

2. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, wherein the cell gas inlet is connected to a source of gas emissions, and the cell gas outlet discharges treated gas for discharge to the atmosphere.

3. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, additionally including a gas mixing chamber having a first mixing chamber gas inlet connected to the cell gas outlet and a second mixing chamber gas inlet, the mixing chamber mixing gas entering the chamber from the first and second mixing chamber gas inlets, and a mixing chamber gas outlet for discharging gas that has passed through the mixing chamber.

4. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 3, wherein the gas to be treated is divided into two portions, one portion being directed to the cell gas inlet to be treated in the cell and the other portion being directed to the second mixing chamber gas inlet.

5. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 3, wherein the gas to be treated is directed to the second mixing chamber gas inlet and atmospheric gas is directed to the cell gas inlet.

6. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, wherein the NTP generation cell comprises a plurality of NTP generation cells arranged in parallel configuration.

7. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 6, wherein three NTP generation cells are arranged in parallel.

8. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 7, wherein each of the three NTP generation cells are powered by one phase of a three phase power source.

9. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, wherein the hot electrodes are hermetically sealed with a ceramic material.

10. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 9, wherein the ceramic material is a borosilicate glass.

11. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 10, wherein the borosilicate glass is in the form of sheets placed on opposite flat sides of the electrode and the edges of the glass sheets are sealed with an electrically insulating material.

12. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 11, wherein the electrically insulating material is a high voltage silicone sealant.

13. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, wherein the electrodes of the NTP generating cell are positioned in alternating relationship in a non-conductive rectangular frame.

14. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 13, wherein the hot electrodes each have a perimeter and are hermetically sealed by sealing material which extends beyond the perimeter of the hot electrode, the hot electrodes being held in the frame by the sealing material extending beyond the perimeter of the electrode so each hot electrode is held in the frame spaced from the frame.

15. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 14, wherein a NTP field is generated between electrodes when power is applied to the electrodes and the perimeter of the hot electrodes establishes a perimeter for the NTP field generated between electrodes substantially equal to the perimeter of the hot electrodes, whereby the NTP field is kept away from the frame.

16. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 15, wherein there is one more ground electrode than hot electrode.

17. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 1, wherein power is applied to the electrodes to generate a NTP field between the electrodes, and wherein the power is an AC voltage of between about 4,000 volts and about 100,000 volts at a frequency of between about 50 Hz and about 50,000 Hz.

18. Apparatus for treatment of odor and volatile organic compound contaminant in gas emissions according to Claim 1, additionally including a dielectric barrier discharge NTP generation cell power control system and an ozone sensor in the treated gas leaving the apparatus, the ozone sensor providing an indication of the ozone content of the treated gas, the ozone content of the

treated gas being indicative of the extent of treatment of the gas, the indication of ozone content of the treated gas being transmitted to the control system to control the power provided to the cell.

19. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions, comprising:

- a dielectric barrier discharge NTP generation cell having a gas flow path therethrough, said cell having a plurality of electrically hot electrodes and ground electrodes positioned in the gas flow path so that gas flowing in the gas flow path will flow across a portion of these electrodes;

- a cell gas inlet leading to the gas flow path through the cell;

- a cell gas outlet for discharging gas that has passed through the cell;

- a gas mixing chamber having a first mixing chamber gas inlet connected to the cell gas outlet and a second mixing chamber gas inlet, the mixing chamber mixing gas entering the chamber from the first and second mixing chamber gas inlets; and

- a mixing chamber gas outlet for discharging gas that has passed through the mixing chamber, said inlets being arranged so that the cell gas inlet is selectively connected to a source of contaminated gas to be treated, to a source of atmospheric air, or to sources of both contaminated gas and atmospheric air.

20. A dielectric barrier discharge non-thermal plasma generation cell, comprising:

- a plurality of electrically hot electrodes;

- a plurality of ground electrodes;

- a fluid flow path formed between said ground electrodes and said hot electrodes so that a fluid flowing in the fluid flow path will flow across a fluid flow portion of the electrodes;

- dielectric material hermetically sealing each of the plurality of hot electrodes across the fluid flow portion of the electrodes;

a cell fluid inlet leading to the fluid flow path through the cell; and

a cell fluid outlet for discharging fluid that has passed through the cell

21. A dielectric barrier discharge non-thermal plasma generation cell according to Claim 20, wherein the electrodes of the non-thermal plasma generating cell are positioned in alternating relationship in a non-conductive rectangular frame.

22. A dielectric barrier discharge non-thermal plasma generation cell according to Claim 21, wherein the hot electrodes each have a perimeter and are hermetically sealed by sealing material which extends beyond the perimeter of the hot electrode, the hot electrodes being held in the frame by the sealing material extending beyond the perimeter of the electrode so each hot electrode is held in the frame spaced from the frame.

23. A dielectric barrier discharge non-thermal plasma generation cell according to Claim 22, wherein a non-thermal plasma field is generated between electrodes when power is applied to the electrodes and the perimeter of the hot electrodes establishes a perimeter for the non-thermal plasma field generated between electrodes substantially equal to the perimeter of the hot electrodes, whereby the non-thermal plasma field is kept away from the frame.

24. A dielectric barrier discharge non-thermal plasma generation cell according to Claim 23, wherein there is one more ground electrode than hot electrode.

25. Apparatus for treatment of odor and volatile organic compound contaminants in gas emissions according to Claim 20, wherein power is applied to the electrodes to generate a non-thermal plasma field between the electrodes, and wherein the power is an AC voltage of between about 4,000 volts and about 100,000 volts at a frequency of between about 50 Hz and about 50,000 Hz.

26. A method of treating odor and volatile organic compound contaminants in gas emissions comprising:

passing a gas through a dielectric barrier discharge non-thermal plasma generation cell to create a range of reactive oxygen species in the gas which causes oxidation and/or reduction of odor causing molecules and volatile organic compounds; and

mixing the gas to be treated with the gas having been passed through the dielectric barrier discharge non-thermal plasma generation cell to allow the reactive oxygen species to react with the odor causing molecules and volatile organic compounds in the gas to be treated.

27. A method of treating odor and volatile organic compound contaminants in gas emissions according to Claim 26, wherein the gas passed through the dielectric barrier discharge non-thermal plasma generation cell includes at least a portion of the gas to be treated.

28. A method of treating odor and volatile organic compound contaminants in gas emissions according to Claim 26, wherein the gas passed through the dielectric barrier discharge non-thermal plasma generation cell is atmospheric air.